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CONTENTS

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SOME NEEDS OF ENGINEERING[1]

LET me remind you that the practise of our art is still empirical in that most fundamental matter, the strength of the materials which we use, their ability to resist the stresses to which we expose them. It will suffice to touch on two phases of this matter, that our reception tests are quiescent, though in many cases they should be kinetic, and that they do not determine the true resistance of the material even to relatively quiescent stress, as it is applied in many important services. Let us consider these two in series.

It should be an axiom that reception tests should represent the most trying service stresses, which in many important cases are kinetic, arising from impact, shock or very rapid application of stress. This is true of gun hoops, shells, rails, tires, axles, and many parts of motor cars, and of agricultural and other important classes of machinery. The fitness of such materials for enduring these kinetic stresses should be determined primarily by means of impact tests. For each service the severity of this impact should represent the greatest and most rapidly applied stress which is to be expected.

What would you say to using a hydraulic press to determine the ballistic resistance of armor plate or the resistance of a safe to a burglar's sledge? Yet it is only in degree that our present practise is less rational than this, and it is only because fa-

[1] Address of the Vice-president and Chairman of Section G, of the American Association for the Advancement of Science, Pittsburgh, December 28, 1917.

miliarity has dulled our sense of incongruity that we do not rebel against its irrationality.

Machines for determining quantitatively the resistance of steel to impact of any desired degree of violence have been on the market for about twenty years, and they have come into use to a considerable extent in Europe for reception tests, though even there they have not received a fraction of the attention which they deserve, so fully has habit blinded us to the irrationality of our present practise. These machines measure quantitatively the energy consumed in breaking a test piece under impact of given violence, and also the capacity of the material for plastic deformation under these same conditions.

It is pure empiricism to measure fitness for these kinetic conditions by applying a factor of safety to the results of quiescent tests. Not only must such a factor be a matter of guesswork, but that which suffices for certain materials is wholly insufficient for others. We know that certain steels, which we call "fragile," behave well under quiescent tests, but are very brittle under impact. A factor suitable for them would involve a great waste if applied to infragile steel, while one suited to infragile steel might lead to death and disaster if applied to that which is fragile. Unfortunately the fragile and infragile can not be distinguished by our present quiescent tests, though certain causes of fragility can be detected with the microscope. Under these conditions, unhesitatingly preferring waste to disaster, we adopt a factor suited for fragile steels. This in turn means that we load the community with the cost of a superfluity of material in that large majority of cases in which we use infragile steel, lest we invite certain disaster by our present neglect to take the simple precautions of using the impact test so as to detect fragility. To secure infragility by regulating the composition of the product and the process of manufacture is far better than nothing; but these precautions, which the buyer can enforce with difficulty if at all, should in his interest be supplemented by the direct and positive exclusion of fragile material by means of the impact test.

A like overloading occurs through our trying to provide for the shocks incident to these kinetic services by requiring great plastic deformability, which we currently call "ductility," in the shape of permanent elongation and contraction of area under quiescent tests. This provision at first seems wholly irrational, because these services imply no appreciable plastic deformation, so that we demand properties which will never be utilized. Neither guns, nor rails, nor tires deform plastically in use to an appreciable extent. The excuse is that to increase the ductility, even that determined quiescently, is to increase the power to endure shock. Unfortunately the shock resistance thus implied is far less in fragile steels than in infragile ones, so that in order to secure enough of it for the fragile steels which we may use unwittingly we specify a degree of ductility wholly superfluous in infragile ones. This superfluous ductility is very costly, whether it is got without sacrifice of strength by means of special heat treatment or composition, or, sacrificing unit strength, by using much more of a much weaker steel, following the principle that for given grade of steel, every gain of ductility carries with it a corresponding loss of strength. We could save this needless expense by using the impact test and thus detecting fragility, for then we could lessen the ductility which we exact to that needed for infragile steels.

It is beside the mark that for many uses, including some kinetic ones, more material is needed for rigidity than for strength,

and that here the teachings of the impact test would not lead to economy. That cast iron is strong enough for sash weights, flywheels, and bedplates does not prevent our heat-treating alloy steels for aeroplanes.

Turning to our second subject, my assertion that we do not determine the true resistance of our material even to relatively quiescent stress refers to fatigue strength, the resistance to stresses applied repeatedly. Of the four properties which we habitually determine, the elongation and reduction of area certainly throw little light on fatigue strength, nor can we expect much from the tensile strength, which represents the exaltation of the elastic limit induced by the plastic deformation after the initial elastic limit has been passed. This deformation can not be tolerated in hypo-elastic services, that is in those which demand that each member must retain its initial size and shape, and here the ability of the material to undergo the resultant exaltation of its elastic strength is useless, save as forming a basis for calculating the ductility from an additional point of view, through the elastic ratio, and thus supplementing the elongation and reduction of area as suggestions of impact resistance. How is it then with the fourth of these properties which we determine, the elastic limit?

Before answering this, it is well to refresh our conception that, because the innumerable ferrite and cementite grains of our steel lie with their slip planes inclined in every possible direction, and because the stresses are not distributed exactly evenly throughout the member or test piece, there is some one slip plane in some one grain that is less favorably disposed than any of the others towards the existing stress. That is the weakest spot in the bar. If we increase the stress gradually, slip occurs along that slip plane before anywhere else. The failure of this metal to bear its load tends to overload its neighbors. The stress which causes slip along this weakest plane is strictly speaking the true elastic limit, because this slip changes the dimensions of the bar permanently. Perfect elasticity, the power to return exactly to the initial dimensions, exists only below this limit of stress, which hence by definition is the elastic limit. That this first slip can not now be recognized and probably never can be affects this inference as little as our inability to see atoms and molecules interferes with our belief in their existence.

The elastic limit which we determine with our extensometers may, for clearness, be distinguished from the true elastic limit by calling it the "observed elastic limit." That is must needs recede as our extensometers become more sensitive and must thus approach the true elastic limit asymptotically, is clear.

If this stress which has caused the first incipient slip is released, the elasticity of the rest of the metal reverses the slip, and if the stress is quickly reapplied new slip recurs along this same plane, and so on with quickly succeeding applications of stress, according to our conception, which, moreover, holds that this repeated slipping back and forth causes local degeneration. Moreover, the overloading of the adjoining parts by the slip along this one slipping plane leads them in time to begin slipping, so that after many repetitions of the cycle this degeneration extends through so much of the section that the remaining sound metal is unable to sustain the stress, and hence breaks. This leads naturally to the conception that the true elastic limit is the fatigue strength.

Without insisting on the accuracy of this picture, it certainly helps us to understand why our present observed elastic limit does not measure the fatigue strength, and stimulates us to determine much earlier

stages of slip, in the hope that as we approximate the true elastic limit we shall thereby approximate the fatigue strength as well.

Two methods which might lead to much closer approximations than can be expected from refining our direct measurement of the changes of dimension by means of extensometers, are the thermal and the magnetic.

In the thermal method, the fatigue strength is determined as the stress of which rapid repetitions cause a detectable rise of temperature, supposed to represent the heat evolved by the friction along the first slipping planes. This method owes its attractiveness to our conception that the thermo-electric measurements of temperature seem intrinsically capable of greater sensitiveness than the direct measurement of length. On further examination the method loses some of its promise, for though a slip over a very minute area might yield enough heat to be detected if it lay at the very outside of the specimen, if it were deep-seated it might not, because the heat in working outwards would spread itself over a very large area of surface, and this would lessen correspondingly the actual rise of temperature. Hence if we took the stress which causes the first detectable rise of temperature as our best approximation to the fatigue strength, our results might vary greatly with the position of the first slipping area.

The magnetic method would determine the fatigue strength as the least stress of which repeated applications cause a detectable change in the magnetic properties. The developments of this method which are now occurring at the Bureau of Standards deserve our most careful attention.

From the fact that the ability to endure many millions of repetitions of stress is much less than the observed elastic limit, and from our natural explanation that the difference represents some form of progressive degeneration under indefinitely repeated stresses, we naturally infer that when the repetitions are in the hundreds of thousands a like but smaller degree of this same degeneration occurs. From this in turn we infer that even when the repetitions are only in the thousands this degeneration may occur, though in correspondingly smaller amount. From this we generalized that the gap between the observed elastic limit and the safe working load should increase as some function of the number of repetitions of stress to be expected during the life of the member, and we ask whether this increment should not be considered even in designing bridges, and whether it should not increase with their expected life and the frequency of the passage of trains.

A natural question which arises in this connection is whether, as regards fatigue strength, that part of the elastic limit of steel which is caused by a low finishing temperature in rolling is valid or fictitious and removed during the exposure to repeated stresses. The great life of piano wires, strained very severely and exposed to a repetition of stress with each sound wave, and of suspension bridge wires, both of which owe much of their elastic strength to cold deformation in the shape of wire drawing, is reassuring. An interesting case is that of piano wire, which is credibly reported to have sprung back into a helix when cut after fifty-four years' service, showing that it retains even through its enormous number of repetitions of stress the bending given it in coiling it.

Struggling as we are for our national existence, these pale thoughts move us hardly more than the remembrance of his last month's rent stirs the shipwrecked swimmer in his landward struggles.

It is well to ask ourselves frankly how we come to be in this peril to which our minds revert irresistibly. How is it that we and our allies, excelling the Teutons in both the ponderables and the imponderables, in material resources, in wealth, and in population, on one hand, and with immeasurably higher ethical standards on the other, yet can point to no clear evidence of victory? We know that we excel in organizing power. We know that they have no product of organization comparable with our industries of the Ford motor car, the Bell telephone, the Ingersoll dollar watch, the Eastman Kodak, or the United States Steel Corporation. We know that the organization of our transportation is of a higher order of merit than theirs. We know that in these three years the British have made even a better war organization than the forty-four years since Sedan have given Germany. How comes it then that though we are incomparably stronger, richer, and more capable, we are yet in danger of defeat, of national overthrow, of becoming a German satrapy, a second Belgium or Poland? Do we not know that our disadvantage lies in our political system, and that in this struggle for existence it is not showing itself clearly the fittest for survival? Have we not lost sight of this terrible law of the survival of the fittest, not the fittest ethically, or spiritually, or intellectually, but the fittest to destroy competitors physically? What are the ethics of the snake, the tiger, or the hyena that they have survived in this struggle? The bloodthirsty buccaneers were neither the ethical nor the spiritual betters of the Aztecs and Incas. The Romans were the inferiors of the Greeks, yet they overthrew them, and in turn were overthrown by the barbarians. Fitness for survival must be physical.

It is well to ask ourselves frankly whether we have not been living in a fool's paradise. We have rejoiced in the merits of our political system, in the kind of men and women which it has bred, through opening every career to all, through stimulating each one to strive to his utmost in his chosen path. In our natural rejoicing have we not shut our eyes obstinately to its defects? Have we not refused to see that our system necessarily impels those in office to direct their energies towards their own re-election rather than towards the welfare of the state, to please and propitiate the electors rather than to direct and inspire them, to tell them what it is their wish rather than their true interest to hear, and thus in effect to substitute the temporary opinions of the majority, unfamiliar with state matters, for the vision of the born leaders as the determinant of state policy? We rejoice that our system educates the voters in statecraft, that it broadens their horizon, that it breeds strong units, but we have been too weak, too self-complacent to remedy its defects of leaving those units uncemented, so that they form what may be likened to a friable sandstone, a whole which, in spite of being composed of extremely strong units, is yet incoherent.

The state has as a most important duty this strengthening of the individual units, but that does not justify neglecting the equally important duty of perpetuating itself. We make a fetish of our political system and regard its designers as inspired. They certainly were most intelligent and patriotic, and builded well—considering how little actual experimental evidence they had to guide them. But we should not hold their system sacrosanct. Indeed, one essential part of it, the electoral college, soon proved wholly impracticable, impotent to do its work of selecting a president, and became a mere registrar of decisions reached by others. This promi-

nent failure shows what their system really was, an attempt by frail human beings, with very little to guide them, to devise the most difficult of all human institutions, the government of a country. The corruption of our municipal governments is another clear proof of the fallibility of our forefathers, for all these faults result from the environment which they created, and mean that it misfits human nature in these respects.

Naturally erring in the direction of overguarding against the governmental fault from which they were smarting, irresponsibility and consequent tyranny, they devised a government which, as we now see, is so weak as to be terribly helpless, indeed in danger of an impotence which may prevent it from defending itself efficiently against aggressors.

It is this weakness that has put us in our present peril. When Germany began her attempt to conquer the world, her purpose was evident to every broadminded man, and must have been foreseen clearly by many of our political leaders. It was indeed pointed out repeatedly by contributors to the newspapers, and was neither denied nor questioned, but only ignored, with the result, which was clearly inevitable and as clearly predicted, that she has been able to fight her enemies in detail. A government made strong by the fundamental law of the land would have exposed this peril to the voters, and we should not have had for allies an impotent Russia, a crushed Belgium, Servia and Rumania, and a sorely pressed France and Italy. Indeed, it was the known weakness of our system that made the war possible.

A curious contradiction is that the weakness of the government is matched by a tying of the peoples' hands. Not only are we debarred from selecting our rulers and confined to choosing between candidates administered to us by irresponsible organizations, but once we have chosen both we and our representatives are impotent to remedy an error in choice, by compelling a change in administration, as is done with great profit in Britain, France, and elsewhere. Frankly, we should face squarely the fact that our governmental system, as the first of the great experimental democracies, was the work of apprentices, and we should strive earnestly to mend it as soon as we have passed our present frightful peril.

The system and checks and balances, in weakening the people, their representatives, and the administration alike, has put the power taken from them into the hands of irresponsible organizations, the political machines.

I criticize none. The errors of individual officers, from the constable to the President, flow from our system itself. It is the system that needs betterment.

HENRY M. HOWE

FOOD-BORNE INFECTIONS[1]

GASTRO-INTESTINAL disturbance traceable to some food eaten shortly before is a common occurrence and is indeed part of the experience of many persons. Not long since, the majority of such attacks were declared due to "ptomain poisoning" and were deemed to be sufficiently explained by this designation. It was believed, though never, it must be confessed, on very good evidence, that the foods responsible for the trouble had been kept too long or under improper conditions and had undergone bacterial decomposition or spoiling. This decomposition was supposed to have resulted in the formation of ptomains, a

[1] Address of the Vice-president and Chairman of Section K, Physiology and Experimental Medicine, American Association for the Advancement of Science, Pittsburgh, December, 1917.

name given by Selmi to certain basic compounds formed in the later stages of protein disintegration. Interest in the ptomains was especially stimulated by the work of Brieger, who isolated and stuided (1882–1888) the properties of many of these bodies.

Confidence in the sanitary significance of ptomains has been shaken by many facts. For one thing, ptomains are formed in the later stages of protein decomposition, and by the time they are present, the organoleptic evidences of decomposition have become pronounced. There is little doubt that food containing ptomains would be almost invariably condemned by the senses as nauseating and unfit for use. On technical grounds numerous criticisms have been made with respect to the methods used for isolating and extracting ptomains and for determining their clinical effect. Perhaps the principal reason, however, for the decline in the belief that ptomains have any important share in the production of food poisoning has been the discovery that in many instances the responsibility can be placed definitely upon other factors. Those outbreaks of food poisoning that have been most thoroughly investigated have been found to be due not to the use of spoiled food containing ptomains but either (1) to the presence of true bacterial toxins comparable to the toxins of the diphtheria and tetanus bacilli and not to be regarded as the simple products of decomposition, or (2) to infection with specific bacteria borne in or upon the implicated food article.

Poisoning from bacterial products in food, when it occurs at all, seems to be due to the accidental and occasional presence of toxigenic microbes which give rise to specific toxins. Little is known about the conditions under which the relatively rare toxigenic bacteria find their way into food stuffs. In the best-known example of this type, the severe poisoning due to the products of *Bacillus botulinus*, certain facts seem to indicate a regional distribution of the microorganisms. In this country 17 of the 22 recorded outbreaks have occurred in California. There is no record of a single case in Great Britain.[2] All told, demonstrated instances of food poisoning due to bacterial products are not very numerous.

On the other hand, the careful investigation of food-poisoning outbreaks has brought to light a very large number of instances of apparent poisoning which are in reality cases of infection with some pathogenic microorganism. The distinction is practically important. The measures that need to be taken to prevent infection are of a different nature from those designed to prevent the use of food containing the products of bacterial growth.

There are still many questions about the use of spoiled foods that need settlement. Some foods such as cheese and sour milk that are loaded with the products of microbic activity appear to be used with impunity, but while we are not yet able to specify with precision the differences between harmful and harmless bacterial action, there can be little doubt that the almost universal preference for fresh food containing as few bacteria as possible rests on a sound physiological basis.

Food-borne infections are essentially of two separate and quite independent classes:

[2] A number of obscure points in botulism intoxication remain to be cleared up. The discoverer and leading student of the biology of the botulism bacillus, Van Ermengem, states that the spores are destroyed by 15 minutes' heating at 85° (185° F.) or by 30 minutes' at 80° (176° F.), but Dickson (*Jour. Amer. Med. Association*, 1917, 69, p. 966) has recently reported observations indicating much greater heat resistance. Further investigation of this important question is urgently needed.

those in which the pathogenic organisms are present in the food at its origin, without human intervention; and those in which the food has become contaminated from human sources during the process of preparation, transportation or serving.

The contamination of food with disease germs on its way from source to consumer may occur through direct contact either with a person suffering from disease or a convalescent or a healthy carrier. From such an individual the specific pathogens may be conveyed to the food by mouth-spray or by contaminated fingers.

It probably does not often happen that such contamination is brought about by a person seriously ill with a specific infection except in the initial or later stages of the malady. The incapacitating effects of most infectious diseases tend to prevent the active participation of the patient in marketing or serving food. Mild or atypical cases, however, of such diseases as typhoid fever are a source of danger, and instances are on record where food-borne infections have originated from definitely affected persons. From the public-health standpoint infection from this source is important and must be guarded against with great vigilance.

In a variety of human infections convalescents constitute an important source of food contamination. As is well known, pathogenic organisms may be present in the nose or throat, in the intestines or in other organs, for some time after clinical recovery has taken place. It is possible in diphtheria and some other infections to determine with a high degree of certainty when the specific germs finally disappear from the body, but unfortunately this knowledge is not always taken advantage of in actual practise. There is reason to believe that in typhoid fever, for instance, patients frequently are released from the hospital while they are still discharging typhoid bacilli from the bowels or bladder. The hospital authorities often do not inform their clients or themselves on this point, and the germ-bearing convalescent is not warned of the danger to family and associates which his condition involves. In some infections the length of persistence of the specific germs can not be determined by present methods, and consequently only rule-of-thumb methods of quarantine are practicable. As matters stand, it is plain that food-handling by those recently convalescent from any infectious disease is always to be avoided; knowledge of this fact should be spread as widely as possible.

It is not necessary to dwell at length on the significance of the true "carrier" in food-borne infections, since in recent years the nature of the disease-carrier problem has been given wide publicity. The term disease carrier is commonly applied to those in whom the specific germ persists far beyond the usual period of convalescence and also to those who harbor a disease-producing microbe, although they have apparently never suffered from a clinical attack. It is evident that this latter group constitutes a peculiarly insidious source of infection, since the possession of disease-conveying power is often entirely unsuspected by the persons affected, and is only revealed by investigations following an actual outbreak.[3] The majority of the

[3] A remarkable instance of a typhoid carrier has been reported by Jundell (*Hygiea*, Festband, 1908; editorial, *Jour. Amer. Med. Assoc.*, 1909, 52, p. 388). The grandmother, 79 years old, of a large family was found in 1908 to harbor typhoid bacilli and had apparently been responsible in her lifetime for some thirty-two cases of typhoid fever in members of her family and in servants and other persons in the household. The period during which this carrier was capable of conveying infection apparently extended over fifty-four years,

"healthy carriers," however, are known to have been recently in contact with patients or convalescents.

Efforts to keep down the number of food-borne infections due to the contamination of food by sick persons, convalescents or carriers are therefore mainly directed to placing the ordinary food manipulations in the hands of healthy persons and of those who have not been recently in contact with the sick. This task is somewhat simplified by the rather limited number of diseases likely to be conveyed through such agencies. The chief food-borne infections hitherto traced to human contamination are typhoid fever and the various paratyphoid infections. To these must be added certain infections transmitted in milk which are rarely, if ever, conveyed in other food-stuffs. Outbreaks of diphtheria, scarlet fever and streptococcus sore throat due to milk have been reported in considerable numbers, but foods other than milk probably seldom serve as the vehicle of these diseases. In the majority, if not in all, of these cases, the specific germ enters the milk directly from human sources. It is probable, however, that in some instances a secondarily infected cow must be held responsible. It is theoretically possible for the bacillus of human tuberculosis to be transmitted by food, but evidence of the frequency of such transmission is not readily forthcoming. Even the contamination of milk by a tuberculous milker is not easy to prove. Since it is almost impossible to trace most cases of tuberculosis to their origin, any precise evaluation of source of infection in this disease is at present out of the question. Technical difficulties, however, should not be allowed to override the application of analogies drawn from other diseases. It seems entirely reasonable to suppose that milk and other foods can become contaminated in the course of their collection or handling by a person discharging human tubercle bacilli. In the recent examination in New York City of 1980 food-handlers, 10 cases of active tuberculosis were found. The agency of flies in bringing about the contamination of food both with tubercle and typhoid bacilli must also be taken into consideration.

1854–1908. The disease was confined strictly to this one family, and the neighborhood was free from typhoid fever during all these years.

It can not be forgotten that there is a possibility of the multiplication of pathogenic bacteria in food. In general, microorganisms pathogenic for man do not increase freely outside the human body, and when discharged into the air, water or soil, quickly perish. But in many foods conditions obtain very much like those in the artificial culture media used in laboratories. If such foods become contaminated with pathogenic bacteria, a considerable increase in bacterial numbers may occur. In point of fact, it has been observed that multiplication of this sort does take place. There are many instances where the incriminated food, when fresh, gave rise to little or no injury, but after standing 24 hours or less without visible signs of decomposition produced numerous cases of illness. Especially significant is the large number of outbreaks in which such foods as meat jellies, meat pies, salads and made dishes generally have been inculpated. A very large proportion of the recorded outbreaks has been traced to foods that have been prepared for the table and then allowed to stand before being eaten, or that have kept over to a second or third day as remnants after the first serving. Cooking, so far from surely destroying all bacteria, may in some cases provide a favorable temperature for bacterial multiplication, as in the celebrated California

outbreak of 93 cases of typhoid infection due to a dish of baked spaghetti. Here it was found by subsequent experiment that the degree of heat reached in the interior of the dish was an incubating rather than a sterilizing temperature. Milk, which is an excellent culture medium, is a food particularly liable to become dangerous through the multiplication of bacteria. The mixing of milk from many farms at a central station tends to disseminate any contamination present through the whole supply. One typhoid carrier on a single farm may therefore lead to the contamination of a large volume of raw milk and to an extensive epidemic. The pasteurization of milk offers a satisfactory method of meeting this danger.

Besides the various modes of direct contact there are more roundabout methods of food contamination from human sources of infection. One possibility is the transmission of typhoid infection by vegetables grown on land fertilized by night soil. The practise of manuring truck gardens with human excreta is not unknown in this country and is believed by some to be increasing. Melick[4] has shown that typhoid bacilli may remain attached for several weeks to lettuce and radishes grown in contaminated soil, a period quite sufficient for the maturing of these vegetables. He also showed that the bacilli are not removed from the surfaces of the vegetables by the ordinary methods of washing used in preparing such foods for the table.

The second type of food-borne infection, that in which the food itself is contaminated at its origin and does not simply pick up contamination en route to the consumer, is especially exemplified in the case of certain infections of the ordinary food animals. Food plants are not attacked by any microorganism pathogenic to man, with perhaps the single exception of the coconut palm, in which a disease called bud-rot is said to be caused by a variety of *B. coli*, an organism usually harmless but under some conditions slightly pathogenic for man. The rather numerous species of bacteria that cause the diseases to which the common garden vegetables are subject are none of them, so far as known, pathogenic for man or other animals. On the other hand, many food animals suffer from bacterial infections that may be communicated to man.

[4] *Jour. Infect. Dis.*, 1917, 21, p. 28.

Milk is probably the animal food that serves most commonly as the vehicle of this type of infection. It has been definitely established that the bacillus of bovine tuberculosis may be present in the milk of a diseased cow and that the use of such milk in a raw state is a source of human infection, particularly in young children. Milk from diseased animals may also produce infection in foot-and-mouth disease, in Malta fever (goat's milk) and in some other diseases. In many cases the condition of the animal is such as to give ample warning, in others the danger is not so readily apparent. Adequate pasteurization of the milk is a safeguard against this mode of infection as well as against infection with milk contaminated from human sources.

Other food products originating from diseased animals may contain pathogenic bacteria. A noteworthy number of outbreaks of meat poisoning have been traced to the use of meat from animals ailing at the time they were slaughtered, and later discovered to have been definitely infected. Bacilli of the paratyphoid-enteritidis group are found in a large proportion of these cases, both in the meat of the diseased animals and in the organs or excreta of the persons affected. This class of food infections is of special interest, since in their

sudden onset and acute gastro-intestinal symptoms they present the characteristic features of what is popularly supposed to be ptomain poisoning. They are in reality genuine infections with pathogenic bacilli. Cattle and swine are apparently particularly prone to infection with bacteria of this group, and by far the larger number of meat-poisoning epidemics are due to meat from these animals. The meat of sheep is rarely implicated. It is noteworthy also that a large proportion of the recorded meat poisoning outbreaks are due to raw or imperfectly cooked dishes. Sausages, especially such as are made of raw meat and eaten without cooking, have been incriminated in a significantly large number of cases. Internal organs like the liver and kidneys are more apt to contain bacteria than the masses of muscle commonly eaten as "meat." Unfortunately, inspection of the meat may not give any warning of the presence of pathogenic bacteria. Meat in appearance quite normal to the trained eye of the veterinary has been known to give rise to a meat poisoning outbreak. Neither is it always practicable by a system of live-animal inspection to prevent the marketing of meat from infected animals. Thorough cooking is probably the best means of preventing this as well as all other forms of food-borne infection.

While paratyphoid seems to be the most common form of meat-borne infection, there is a possibility that other kinds of pathogenic bacteria present in the bodies of diseased food animals may sometimes be transmitted to man in meat or meat products. The possible conveyance of tuberculosis in this way has been thoroughly investigated, and it is now pretty generally agreed that in most civilized countries the danger of contracting tuberculosis from meat is not serious. Under any ordinarily careful system of inspection tubercle-infected carcasses are not likely to be marketed without restriction, and the thorough cooking to which meat is commonly subjected is a further and efficient safeguard. It is apparently true also that very large numbers of tubercle bacilli are necessary to produce infection of human adults through the alimentary tract. Altogether the concurrence of favorable conditions for the transmission of tuberculosis by meat is probably rare. Bacilli of the "bovine" type are seldom found in adults. Although theoretically possible, there does not seem to be any convincing evidence that cases of tuberculosis have actually resulted from the use of meat.

In several acute diseases of food animals caused by bacilli pathogenic for man the possibility of human cases being food-borne is even more remote than in tuberculosis. Anthrax is not at all likely to be transmitted through food. Many diseases, such as hog cholera, swine erysipelas and pleuropneumonia of cattle that affect various domestic animals are not known to be transmissible to man in any way. Conversely, typhoid fever and Asiatic cholera are not diseases from which the lower animals suffer, and consequently are not infections that can originate with any food animal.

The chief infections therefore that are known to be due to food infected at its source are those—mainly meat-borne—caused by the group of paratyphoid-enteritidis bacteria and those resulting from the use of infected milk. The methods for preventing food infection are not those of simple inspection of food products. It has been questioned whether the amount of disease prevented by the ordinary methods of food inspection is at all commensurate with the outlay. Chapin[5] in considering the

[5] "The Relative Values of Public Health Procedure," *Jour. Amer. Med. Assoc.*, July 14, 1917, 69, p. 90.

relative values of health work has estimated the value of food sanitation (exclusive of milk) at 10 on a scale of 1,000. He adds:

> The small value here assigned may arouse protest, but who will argue that the laboratory is not five times as important, or baby nurses eight times as important, or the direct control of contagious diseases ten times as important as is food sanitation?

The prevention of food-borne infection at present can be best effected by (1) thorough heating, including especially milk pasteurization; (2) employment of healthy persons for food preparation and serving; (3) examination of food animals at or shortly before slaughter; (4) general cleanliness of surroundings where food is prepared or served; (5) use of food in a fresh condition.

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SCIENTIFIC EVENTS

THE GENERAL MEDICAL BOARD OF THE COUNCIL OF NATIONAL DEFENSE

The general medical board of the Council of National Defense held a regular stated meeting in Washington on January 13. The meeting was an unusually enthusiastic one, even despite the fact that not a few members caught snowbound in the blizzard en route were unable to reach Washington on schedule time. The following members responded to the roll call: Dr. Franklin Martin, member of the advisory commission of the council, chairman; Dr. W. F. Snow, secretary; Surgeon General William C. Gorgas; Surgeon General William C. Braisted; Rear Admiral Cary T. Grayson; Dr. Victor C. Vaughan; Dr. William H. Welch; Dr. Thomas S. Cullen; Dr. Edward P. Davis; Dr. Robert L. Dickinson; Dr. Philip Schuyler Doane; Dr. Joseph Rilus Eastman; Dr. John G. Clark; Dr. Duncan Eve, Sr.; Dr. S. McC. Hamill; Dr. W. H. G. Logan; Dr. Fred Bates Lund; Dr. John D. McLean; Dr. Rosalie Slaughter Morton; Miss M. Adelaide Nutting; Dr. Albert J. Ochsner; Dr. Hubert A. Royster; Dr. J. Bentley Squier; Dr. George David Stewart, and Dr. W. C. Woodward.

For the Army, Colonel Deane C. Howard, dealt at length with the recent perturbing epidemics of measles and pneumonia, but furnished the comforting news that both of these epidemics were at the present moment under adequate control. The admission rate for the past week was lower than it had been in some time, and it was hoped that both morbidity and mortality would in the very near future show a corresponding drop. Colonel Howard also pointed out the satisfactory status of the troops in regard to the venereal problem.

Admiral William C. Braisted, for the Navy, furnished assurance that the health conditions were all that could be desired, considering the factor of seasonal disease. The Navy also has been troubled with pneumonia, and was not a little concerned regarding the question of meningitis. Admiral Braisted expressed great gratification over the fact that his request for a meningitis segregation camp in Florida had been granted. It is hoped to isolate in this camp all meningitis carriers, and to care for them until they are once again safe and serviceable individuals.

Dr. Joseph Schereschewsky, for the Public Health Service, submitted a report detailing the health conditions in the various cantonment zones and what the Public Health Service has been doing to maintain these various zones in a state of good health.

Dr. T. Clark, who reported for the Red Cross, described the establishment of the four sanitary units that are cooperating with the other sanitary forces of the government in a most worthy attempt to aid in the maintenance of a high tone of public health, in addition to cooperating with those officials concerned in the direct maintenance of a low morbidity rate in the Army and Navy proper. Dr. Clark made it perfectly plain that the Red Cross was glad and willing to expend all that was legitimately necessary to accomplish any worthy purpose. If more than the present appropriation called for were needed, it would be forthcoming. If less were needed, there would naturally be a curtailment.

Major William F. Snow reinforced the earlier remarks of Colonel Howard on the prob-

lem of venereal disease in the Army, pointing out how easy it was to misinterpret statistics as applied to this topic, and emphasizing the need for continuous effort in the hope of maintaining the present standard of low morbidity.

For the Army General William C. Gorgas expressed satisfaction with the present state of health in the Army, although he emphasized the importance of the winter epidemics of measles, pneumonia and meningitis. He cautioned against the possible mistake of referring the pneumonia epidemics solely to the cold weather, and was inclined, rather, to feel that this was only an indirect cause. As a result of winter the men naturally segregate and are more closely housed. This may be the important factor, and not the cold weather itself. The general pointed out how this certainly is the case in smallpox, which is also a cold-weather disease, although not directly referable to winter itself, and how, during his service in the Tropics, he lived through epidemics of pneumonia among the troops much more severe than those that the Army health authorities are at present combating.

Major M. G. Seelig explained the principles involved in the daylight saving propaganda, and to aid in the passage of this bill through the House, the following resolution was approved:

Resolved, That the general medical board of the Council of National Defense indorse the plan of daylight saving and lend its influence in securing the passage of a law directed toward this end.

Dr. S. McC. Hamill reported for the committee on child welfare. This committee is made up of the following members: Dr. S. McC. Hamill (chairman), Dr. Fritz Talbot, Dr. H. T. Price, Dr. Frederick L. Hoffman, Dr. J. Whitridge Williams, Miss Hannah J. Patterson, Mrs. Josiah E. Cowles, Dr. Grace L. Meigs, Mrs. Stanley McCormick, Miss Ella Phillips Crandall, Miss Julia C. Lathrop, Mr. Philander P. Claxton and Miss Dorothy Pope. They reported that it was decided for the present to center the attention of the committee on the preparation of a program covering the welfare of the mother, provision of intelligent obstetrical care, and the protection of the life and health of the child during its first two years. The program of the committee in full covers all forms of child-welfare work, placing special emphasis upon maternal and infant mortality, and in this relation centering on details of birth registration, prenatal, obstetrical and infant care. Dr. Hamill presented a resolution directed toward securing the closer cooperation of the medical schools of the country along lines of child-welfare work. This resolution was referred to the executive committee.

Dr. Francis D. Patterson, chief of the division of industrial hygiene and engineering, Pennsylvania department of labor and industry, spoke on the subject of reconstruction, detailing at length the experience of England in reconstructing, rehabilitating, and reeducating her disabled men. Dr. Patterson pointed out the four distinct lines of effort essential in solving the problem of reconstruction. 1. Medical and surgical treatment of the injury and disease. 2. Vocational training. 3. Securing of employment. 4. Maintenance of medical supervision of the man after he has gone back into industry. He also emphasized the necessity of more or less planning of work in educating employers up to the point of recognizing the need of cooperation on their part in the proper utilization of the reconstructed soldier.

Dr. Joseph Schereschewsky made a report for the committee of industrial surgeons, outlining their aims as follows: To provide against unnecessary human waste in industry and society during war. To offset the drain on industry of man power caused by the raising of military forces. To meet the need for greatly increased production. To avoid preventable deaths and disabilities from accident and disease. To restore to full producing power in the shortest possible time sick and injured workers. To increase output by maintaining workers in good health. To provide healthful places in which to work. To provide healthful homes and communities in which to live. To meet shortage of medical service induced by military needs.

Dr. Edward P. Davis, of Philadelphia. sub-

mitted a report advocating the establishment of an auxiliary medical service corps. This corps is intended to utilize the services of those men who, either by age or physical disability, are disqualified from receiving a commission, but who nevertheless are potentially of service to the country and who greatly desire to render this service. The method of election to the medical service corps as recommended by Dr. Davis was as follows: The applicant is to apply by letter to the secretary of the state governing body, who shall mail to the applicant a printed form which, when properly completed, will give full information concerning the applicant and enable his proper classification according to training and special fitness. The name of the applicant, with information concerning him thus obtained, shall be submitted to the committee on elections. The final acceptance of a candidate for membership in this organization is to be by the national governing body. The committee considers it of the utmost importance that members of this organization be suitably designated, and for this purpose recommends that a brassard with appropriate insignia be provided.

Dr. A. Homer Smith reported on the drug situation, detailing important data regarding chemical glassware, digitalis, alkaloids used in ophthalmic practise, novocaine, mercury, and other drugs. He pointed out the urgent need of supply and conservation, and pleaded for complete coordination of all branches of the government on all subjects pertaining to drug and chemical need.

Dr. Philip S. Doane, of Chicago, who has been assigned to duty with the Shipping Board, submitted a report outlining the medical activities carried on in connection with this board. The Shipping Board has at present under its supervision 170,000 men, and it is expected that this number will reach 350,000 within the year. Dr. Doane detailed how these men were being looked after, both as regards the conservation of their health and the treatment of accident and disease prevalent among them, as well as the provisions made for their general welfare, amusement and comfort.

For general surgery, Dr. J. Bentley Squier, of New York, submitted interesting data on the progress that is being made in classifying the various surgeons of the country. These men were classified in accordance with data that they furnished on their own questionnaire, but in addition to this, the surgical committee, in order to code the men in such fashion as to furnish real, valuable data to the government, obtained information by personal investigation both of the personality and of the professional qualifications of the men constituting the various surgical groups of applicants.

Up to date, 21,000 applicants for the Medical Research Corps have been coded in such fashion that at a moment's notice the medical authorities of the War Department may secure almost any desired type of information regarding any individual in the service of waiting for commission.

Miss Ella Phillips Crandall, of the nursing committee, reported on the efforts being made by this committee toward maintaining the nursing standard at a high level, while at the same time securing an adequate number of nurses. This committee has also made inquiries into the question of suitable provision for the nursing care of returned soldiers and sailors in the reconstruction hospitals. This latter work, of course, is being done in close cooperation with those divisions of the War Department and of the Red Cross which have similar work in mind and hand.

Major John D. McLean, reporting for the committee on states activities, announced that the committee had formulated and secured the approval of the Surgeon General's Office for rules of procedure for medical advisory boards.

Dr. Rosalie Slaughter Morton reported for the committee of women physicians that this committee now had on its register the names of 1,796 women physicians, or approximately 33 1/3 per cent. of all the women physicians registered in the United States. It is hoped that these women physicians may be used to help meet the need of internes, laboratory workers, radiographers, and anesthetists. The women physicians of the country are enthusi-

astic and ready for service along these lines, and truly feel that their services would be of aid in winning the war.

For the medical advisory boards, Major McLean stated that all the governors' aides have been appointed, and have been received with hearty accord. It has been the universal report that the services of these governors' aides have been invaluable, and in many instances the governors have requested permission to attach the aides to their offices for the period of the war.

Dr. Victor C. Vaughan submitted the final report of the meeting, emphasizing the necessity of close cooperation between civilian authorities and military authorities in the regulation of health matters concerning both these branches. In the state of Michigan, where very close cooperation exists, infectious diseases occurring in the civilian population necessitates immediate report to the military authorities in the nearby cantonment by telephone or telegraph. This enables the military authorities to institute efficient quarantine against any particular quarter in the state where communicable disease is known to be present. Dr. Vaughan expressed the hope that, were it practical and feasible, close cooperation would be established between all civilian and military health authorities throughout the country.

UNITED STATES DYESTUFFS

THE United States is the only country that has succeeded in establishing a successful dyestuff industry since the war began, and it has been found that American dyes are as good as German dyes, according to a report made by the Bureau of Foreign and Domestic Commerce. Formerly importing annually as much as $10,000,000 worth of aniline dyes alone, this country exported during 10 months of last year $12,500,000 worth of dyes to 21 foreign countries, and exports are growing rapidly. The largest purchaser last year was Britain, which used over $3,000,000 worth of dyes in 10 months.

In view of her situation as to dyes, Britain is congratulating herself on the recent capture of the recipes of 257 German dyes. It is said that these were secured with great danger and difficulty by British textile firms, assisted by the British foreign office. Professor Philip B. Kennedy, commercial attaché of the American Embassy in London, who cabled the news to the United States Bureau of Foreign and Domestic Commerce, says that it is reported that all the recipes have been tested in Switzerland by F. M. Rowe, of the Manchester School of Technology, and certified by a British consular officer. The recipes will be given to the British government, which will establish a dye industry in England.

Delegations from the greatest British dye firms and from those in Switzerland are now in this country to obtain information about the American dyestuff industry, with a view to coordinating their efforts with this country's in covering the world markets after the war.

In this connection it is regarded as particularly significant that some 200 manufacturers of dyestuffs from all parts of the country planned to meet at the Chemists' Club in New York on the twenty-second and twenty-third of January for the purpose of forming a national association. This association when formed will pay particular attention to the high quality of American dyestuffs and the standardization of colors.

Throughout this meeting it is hoped that some coordinated plan may be reached by American manufacturers to cover the foreign field for American dyestuffs in the future.

Among the developments in American-made dyestuffs has been the perfecting of vegetable dyes and mordants. One which has served a particularly useful purpose has been the osage orange dyes, first exploited by the Department of Agriculture, and developed for utilization as khaki dyes for uniform cloth.

THE BOARD OF NATURAL RESOURCES AND CONSERVATION OF THE STATE OF ILLINOIS

THE last session of the State Legislature of Illinois adopted a Civil Administrative Code which provided for a very complete reorganization of the civil administration of the state government in order to secure greater econ-

omy and efficiency. The following departments were created: Finance, agriculture, labor, mines and minerals; public works and buildings, public welfare, public health, trade and commerce and registration and education. A director of each was appointed by the governor. Provision is made for the preparation of a state budget in connection with each department, and in this and in many other ways it is expected that increased economy and efficiency will be secured in the administrative work of the state.

The Department of Registration and Education has charge of the work previously under the Board of Education of the state of Illinois, and the boards of trustees of the state normal schools. It also exercises the powers and duties vested by law in the boards of examiners for physicians, dentists, pharmacists, etc., and supervises the work of the Natural History Survey, Geological Survey and Water Survey of the state. In exercising the latter duty the director of the department is assisted by a Board of Natural Resources and Conservation, which acts through five or more subcommittees, each of which is composed of the director of Registration and Education, the president of the University of Illinois, or his representative, and the expert adviser, specially qualified in each of the fields of investigation covered by the surveys.

The first meeting of the full Board of Natural Resources and Conservation was held at the University of Illinois on Saturday, December 15, 1917. There were present, Director Francis W. Shepardson, who presided at the meeting, Dean David Kinley, representing the president of the University of Illinois, Professor T. C. Chamberlin, Professor John M. Coulter, Mr. John W. Alvord, Professor William Trelease and Professor W. A. Noyes, members of the board, and Professor S. A. Forbes, Mr. Frank W. DeWolf, Professor T. E. Savage, Mr. G. C. Habermeyer and Mr. W. T. Monfort, representing the Natural History Survey, the Geological Survey and the Water Survey.

Professor W. A. Noyes was chosen secretary of the board. The following divisions were organized in accordance with the provisions of the Civil Administrative Code of the State of Illinois:

1. The State Natural History Survey Division, which includes the duties formerly exercised by the state entomologist and the State Laboratory of Natural History,
2. The State Geological Survey Division, and
3. The State Water Survey Division.

The board was organized to include the following subcommittees:

(*a*) A subcommittee in the Natural History Survey Division, including the director, the representative of the president of the University of Illinois, Professor S. A. Forbes, *chief*, Professor John M. Coulter.

(*b*) A subcommittee in the Natural History Survey Division, including the director, the representative of the president of the University of Illinois, Professor S. A. Forbes; *chief*, Professor William Trelease.

(*c*) A subcommittee in the Geological Survey Division, including the director, the representative of the president of the University of Illinois, Mr. Frank W. DeWolf; *chief*, Professor T. C. Chamberlin.

(*d*) A subcommittee in the Water Survey Division, including the director, the representative of the president of the University of Illinois, Mr. W. T. Monfort, Professor W. A. Noyes.

(*e*) A subcommittee in the Water Survey Division, including the director, the representative of the president of the University of Illinois, Mr. G. C. Habermeyer, and Mr. John W. Alvord.

Professor S. A. Forbes was appointed chief of the Natural History Survey Division, Mr. Frank W. DeWolf, chief of the Geological Survey Division, and Professor Edward Bartow, chief of the Water Survey Division.

The chiefs of the respective surveys were requested to prepare a brief statement of the character of the work done by similar scientific surveys and bureaus in other states, and to recommend directions in which the work of our surveys should be developed.

Reports were received from the chiefs of the respective surveys with regard to the work which is now in progress and which has been completed during the past year.

SCIENTIFIC NOTES AND NEWS

At the annual election for officers of the American Philosophical Society, held on Jan-

uary 5th, 1918, the following were elected to serve for the ensuing year: *President,* William B. Scott; *Vice-Presidents,* Albert A. Michelson, George Ellery Hale, Joseph G. Rosengarten; *Secretaries,* I. Minis Hays, Arthur W. Goodspeed, Harry F. Keller, Bradley Moore Davis; *Curators,* Charles L. Doolittle, William P. Wilson, Leslie W. Miller; *Treasurer,* Henry La Barre Jayne; *Councilors,* to serve for three years, Bertram B. Boltwood, Ernest W. Brown, Francis B. Gummere, Herbert S. Jennings.

OFFICERS of the Geological Society of America for 1918, were elected at the recent meeting, as follows: *President,* Whitman Cross, Washington, D. C.; *First Vice-President,* Bailey Willis, Stanford University, Cal.; *Second Vice-President,* Frank Leverett, Ann Arbor, Mich.; *Third Vice-President,* F. H. Knowlton, Washington, D. C.; *Secretary,* Edmund Otis Hovey, New York; *Treasurer,* E. B. Mathews, Baltimore, Md.; *Editor,* Joseph Stanley-Brown, New York; *Librarian,* Frank R. VanHorn, Cleveland, Ohio; *Councilors* (1918–1920), Joseph Barrell, New Haven, Conn., R. A. Daly, Cambridge Mass.

THE officers of the Brooklyn Entomological Society elected at the annual meeting on January 10 are as follows: W. T. Bather, *president;* W. T. Davis, *vice-president;* Chris. E. Olsen, *treasurer;* J. R. de la Torre Bueno, *recording secretary;* R. P. Dow, *corresponding secretary. Publication Committee:* R. P. Dow; *Editor,* C. Schaefer and J. R. de la Torre Bueno.

PROFESSOR R. A. SAMPSON has been elected president of the Scottish Meteorological Society.

THE portrait of Professor Thomas C. Chamberlin, head of the department of geology at the University of Chicago, referred to in a recent issue of SCIENCE, will be presented to the university at the June convocation.

MAYOR HYLAN has appointed Dr. J. Lewis Amster, of the Bronx, health commissioner of New York City, to succeed Dr. Haven Emerson. Dr. Amster is a graduate of the Cornell University Medical School, class of 1902.

DR. R. W. SHUFELDT, of Washington, D. C., having made application for duty on the active list of the Medical Corps of the Army, has been assigned by General Gorgas to the Army Medical Museum. His work will consist in modernizing the present collection and preparing for the incoming medical and surgical material from the front.

THE following committee on the supply of organic chemicals for research during the war has been appointed by the American Chemical Society: E. Emmet Reid, chairman, Roger Adams, H. L. Fisher, J. W. E. Glattfeld, W. J. Hale.

AT the ninth annual meeting of the Amercan Phytopathological Society a movement was started which indicates that plant pathologists are not merely ready but determined to transform their assets and resources into war energy. In order that crop production may be increased by a more concerted effort than ever before put forth to stop the enormous leaks due to plant diseases, a War Emergency Board of seven members was created. The members of the board with the regions which they represent and the special lines of activity which they will supervise are as follows: *Chairman,* H. H. Whetzel, Cornell University, for the northeast, College and Extension Education; F. D. Kern, the Pennsylvania State College, for the central east, Man-power Census and Publicity; H. W. Barre, Clemson College, for the south, Southern Problems and Needs; G. H. Coons, Michigan Agricultural College, for the central states, Fungicides and Machinery, Supplies and Prices; E. C. Stakman, University of Minnesota, for the great plains, Emergency Research; H. P. Barss, Oregon Agricultural College, for the west, Western Problems and Needs; G. R. Lyman, U. S. Department of Agriculture, Plant Disease Survey, and Crop Loss Estimates.

VILHJALMUR STEFANSSON, the arctic explorer, according to Captain A. Lane, who arrived on January 15 at Fairbanks, Alaska, from the Arctic Ocean, bringing direct news from the explorer, was preparing to make a 300-mile dash over the ice north and west of the western Canadian Arctic coast during the

summer of 1918, in search of more new land. Stefansson, he said, intended to leave his present base in April and hoped to reach Wrangel Island, off the northern Siberia coast, in July or August. He planned to spend the 1918–19 winter on the island and end his explorations by sailing through the Behring Strait to Nome, Alaska, in 1919.

New Year honors in Great Britain, as reported in *Nature*, include: *K.C.B* (*Civil Division*): Mr. A. D. Hall, F.R.S., secretary of the Board of Agriculture; Sir George Newman, principal medical officer to the Board of Education. *C.B.* (*Civil Division*); Mr. F. L. C. Floud, assistant secretary to the Board of Agriculture. *Baronet:* Professor James Ritchie, Irvine professor of bacteriology, University of Edinburgh. *C.I.E.:* Mr. P. H. Clutterbuck, Indian Forest Service, chief conservator of Forests, United Provinces. *Knighthoods:* Mr. W. N. Atkinson, who has contributed largely to a knowledge of the dangers of coal-dust in mines; Dr. J. Scott Keltie, editor of *The Statesman's Year-Book,* and for many years secretary of the Royal Geographical Society; Dr. A. Macphail, professor of the history of medicine, McGill University, Montreal. In addition a large number of medical men have received honors for services rendered in connection with military operations in the field.

The lecture arrangements at the Royal Institution include the following: Professor J. A. Fleming, a course of six experimentally illustrated lectures, adapted to a juvenile auditory, on "Our useful servants: magnetism and electricity"; Professor W. M. Flinders Petrie, three lectures on Palestine and Mesopotamia—discovery, past and future; Professor Arthur Keith, three lectures on the problems of British anthropology; Dr. Leonard Hill, two lectures on (1) the stifling of children's health, (2) the climatic adaptation of black and white men; Sir R. T. Glazebrook, two lectures on the National Physical Laboratory; Sir Napier Shaw, two lectures on illusions of the atmosphere; Professor W. J. Pope, two lectures on the chemical action of light; M. Paul H. Loyson, two lectures on the ethics of the war; Sir J. J. Thomson, six lectures on problems in atomic structure. The Friday meetings will commence on January 18, when Sir James Dewar will deliver a discourse on studies on liquid films. Succeeding discourses will probably be given by Professor J. Townsend, Professor A. S. Eddington, Principal E. H. Griffiths, Professor A. G. Green, Professor E. H. Barton and Sir J .J. Thomson.

At the annual meeting of the Washington Academy of Science Dr. W. H. Holmes, of the U. S. National Museum, gave an address on "Man's place in the cosmos as shadowed forth by modern science."

A series of illustrated lectures dealing with science in relation to the war will be presented before the Washington Academy of Science during the present year. The first address of this series was given by Major S. J. M. Aul, of the British Military Mission, on "Methods of gas warfare," on January 17.

Mr. W. C. Mason, British imperial entomologist, died at thirty-three years of age on November 28, at Zomba, Nyasaland, of blackwater fever.

Professor C. Christiansen, professor of physics in the University of Copenhagen from 1886 to 1912, died on December 28, aged seventy-four years.

UNIVERSITY AND EDUCATIONAL NEWS

The bond issue of $1,000,000 voted by the legislature for the University of Tennessee has been sold and it is expected that the money will be immediately available.

The Carnegie Corporation will defray the expense of repairing the buildings of Dalhousie University, Halifax, which were damaged by the explosion on December 6. It is estimated that the amount necessary for repairs will be about $20,000.

Miss E. C. Talbot, of Margam, has presented to University College, Cardiff, an endowment of about $150,000 for a chair in preventive medicine. The first occupant of the

chair is to be nominated for election by the council by an expert board, of which Sir Wm. Osler is chairman.

AT the request of the federal government a free course in wireless telegraphy will be given at Bowdoin College. Professor Charles C. Hutchings and Professor Rhys D. Evans are to be in charge of the course.

DR. RAYMOND PEARL, biologist in the Maine Agricultural Experiment Station, and at present at the head of the statistical department of the United States Food Administration, has been appointed head of the department of biometry and vital statistics in the new school of hygiene and public health of the Johns Hopkins University.

DR. PHILIP A. SHAFFER, of Washington University, has been called to the national service. He has been succeeded by Dr. A. Canby Robinson, associate professor of medicine.

MR. ANDREW BOSS has been appointed vice-director of the Minnesota Experiment Station in addition to his present duties.

DR. C. H. SHATTUCK, recently head of the department of forestry at the University of Idaho, has accepted an appointment as professor of forestry in the University of California.

DISCUSSION AND CORRESPONDENCE

A SUGGESTION TO MORPHOLOGISTS AND OTHERS

IN the course of a year I look over a good many zoological papers on different topics outside of my own work—papers on genetics or the many aspects of embryology or ecology—and I am impressed with a general carelessness which exists among the writers on one point which probably seems unimportant to many of them but which to me seems of very considerable moment. The point is that very few of them give the name of the taxonomist who identified the species with which they have been working, nor do they indicate the preservation of typical material of the adult form so that the specific identification can be tested at any time.

Confusion has already resulted from this lack, and more will come. In many cases very great uncertainty exists as to the exact species with which the writer was working. If I were to write a paper in which the name of a beetle was given, my accuracy would be attested by the fact that I inserted, in parenthesis, "Determined by Schwarz" or "by Casey" or "by Fall," or, if it were a Protozoan, the same thing would happen if I inserted in parenthesis "Determined by Calkins," or, if it were a cactus, "Determined by Rose" or "by Trelease," or if it were a fly, "Determined by Knab" or "by Aldrich" or "by Johnson" or "by Malloch" or "by Parker" or "by Townsend." Such a statement as this would at once set at rest any question of accuracy, and would at the same time indicate the probable place at which representative specimens could be found in case of accident to the author of the paper or in case he should not himself preserve such material.

I have never done any embryological work, and in the recent work on chromosomes and the like I do not know how important it is that specific identification should be made of the forms studied; it may be entirely unimportant, if the genus is all right. But knowing, for example, that there are more than fifty species of *Drosophila* in the United States, it gives me an idea of inexactness when I see so many of these recent genetic papers, having to do with this genus, in which no species is mentioned. The writers seem to be entirely indifferent on this point.

Beginning with Howard Ayres's well-known paper "On the Development of *Œcanthus niveus* and its Parasite Teleas," in which he writes in one place of teleas as "a parasitic Ichneumon fly" and in another as one of the "Pteromalidæ," a paper which was awarded the Walker Prize for 1883, and concerning which it must be said that no true teleas has ever been reared from *Œcanthus* eggs,[1] and extending down to the present day, hundreds

[1] It is quite possible that the parasite which Ayres had was *Polynema bifasciatipenne* Girault, a species belonging to an entirely different family—the Mymaridæ.—L. O. H.

of papers have been published with almost equal lack of precise and attested knowledge of the identity of the form treated.

Of course some workers are more careful than others. E. B. Wilson seems to me to be a man who wishes to know exactly what he is working with. The same may be said for J. T. Patterson and for S. I. Kornhauser and others, but on the whole I think that this suggestion is worth while and I hope that it will appeal to many.

L. O. Howard

SCIENTIFIC BOOKS

The Anatomy of Woody Plants. By Edward Charles Jeffrey. University of Chicago Press, Chicago. October, 1917. With 306 illustrations. Pp. x + 478. Price $4.

This work, by the well-known professor of plant morphology in Harvard University, has been expected with much interest. The expression in the Preface, "Woody or so-called vascular plants," suggests that the two terms are synonymous, and, as a matter of fact, herbaceous forms are by no means neglected, though special prominence is given to the woody types, in accordance with the author's belief in their primitive nature.

Great stress is laid throughout on the supposed "Canons of Comparative Anatomy" formulated in Chapter XVII. It is even stated in the Preface that "any conclusions not in harmony with them have ordinarily not been considered" (with certain exceptions). This at once indicates the highly deductive character of the treatment, though the word "induction" is often used. The book, in fact, is essentially an able exposition of the views of Professor Jeffrey and his school; it will therefore be read with the most advantage by those who are in a position to read critically.

The general plan of the book is as follows: After a short chapter on the cell, we come to the tissue-systems. Next follows a chapter on wood in general, succeeded by four on the secondary wood and one on the phloem. The epidermis and the fundamental tissues occupy Chapters IX. and X. Then we have a chapter on the definitions of the organs, succeeded by three on the root, stem and leaf, respectively. Then follow two chapters, which it is a welcome surprise to find in an anatomical textbook, on the microsporangium, and on the megasporangium and seed. We then arrive at the important Chapter XVII., which lays down the author's "Canons of Comparative Anatomy." The arrangement of the next twelve chapters is systematic, from the Lycopodiales to the Monocotyledons. Chapter XXX. is an anatomical structure and climatic evolution; Chapter XXXI. treats of the evolutionary principles exhibited by the Compositae, and the last chapter is devoted to anatomical technique. The arrangement involves a certain amount of repetition, which, however, serves to bring out the points on which the author desires to lay special stress.

In defining the tissue-systems the author returns to Sachs's old divisions, the epidermal, fibrovascular and fundamental systems. The stele, so prominent as an anatomical unit in the work of the last quarter of a century, thus disappears; it is rarely mentioned and is not to be found in the index. This striking reversion in terminology is intimately connected with the author's theory that the pith is of common origin with the cortex and so does not belong to the central cylinder.

Much attention is given to the wood (especially the secondary wood) as this is the tissue for which the best fossil evidence is available; The libriform fibers are derived from tracheides, not from parenchyma as Strasburger held. Evidence is given also for the origin of xylem-parenchyma and of the so-called medullary rays from tracheides, and some excellent new figures of Lepidodendroid structure are furnished, in support of this view.

The statement (p. 49 and elsewhere) that tangential pits are absent in Palæozoic woods, is erroneous; they have long been described in *Pitys antiqua* and also occur in *Mesoxylon multirame* and doubtless in other species. In Chapter VII. there is an excellent comparative account of xylem-vessels in Gnetales and Angiosperms.

The epidermis is said to be of "relatively slight phylogenetic interest." Yet the stoma is probably the most conservative organ of plants.

The common term *medullary* rays is repeatedly condemned, on the ground that their relation to the pith is only a "semblance," due to obsolescence of the primary wood. This may be true, but the relation is of very old date, for it was already well established in the Calamites and some of the Cycadofilices. From the author's point of view the wide ray is a compound one, derived from the aggregate type of ray; the vascular bundles were not originally separate, and the statements of Sanio and Sachs as to the bridging over of the primary gaps by interfascicular cambium are rejected. They are, however, true, as a description of the facts, and hold good for the young Calamite as well as for more modern plants.

On the general question of the relation of herbaceous to arboreal types, it may be pointed out that there is no proof that our existing herbaceous Lycopods came from arboreal ancestors; the herbaceous *Selaginellites* was contemporary with the arboreal Lepidodendreæ. The siphonostele is held to have primitively possessed phloem on the inner as well as the outer surface. This type of structure, however, is rare among Palæozoic plants.

In the chapter on the Microsporangium the author adopts the view that the higher plants arose from forms like the thallose Liverworts, and quotes Bower's "Origin of a Land Flora" in support of this theory. No mention is made of Professor Bower's subsequent change of view.

The "Canons of Comparative Anatomy" which the author insists on are three in number—Recapitulation, Conservative Organs and Reversion. The doctrine of recapitulation in the development of the individual of the history of the race is well known, though no longer accepted without question. The author points out that *negative* evidence is of little or no value, but doubts may arise as to what testimony *is* negative; in a pine-seedling, for example, short-shoots are absent, but foliage-leaves on the main stem are present.

Among conservative organs the leaf is first cited, and then the reproductive axis. The present writer is given the credit for the latter idea; it belongs rather to Solms-Laubach, but neither generalized the conclusion, which was confined to the peduncles of Cycads. Floral axes are subject to modifications of their own, and are not necessarily conservative. As regards the root, the primary structure is no doubt highly conservative, but it does not follow that the same is true of its secondary modifications.

The word "reversion" is used in a peculiar sense, for certain effects of wounding, believed by the author and some others to be reminiscent of ancestral characters. This doctrine has hitherto been employed only in support of certain controversial opinions, and has not yet been adequately subjected to impartial criticism.

The worst of all such "canons" is that every writer applies them as suits his individual views, and treats inconvenient cases as exceptions.

In the systematic part of the book we first come to the author's well-known division of the higher plants into Lycopsida, without, and Pteropsida, with leaf-gaps in the vascular ring, a classification widely accepted, though it is now realized by many botanists that Sphenophylls and Equisetales have little in common with the Lycopod group.

The author's doctrine of the cortical origin of the pith is applied even to the Lycopods, where the evidence seems peculiarly unfavorable to this interpretation. It is a pity that the exact developmental processes involved are not more clearly explained.

The author's views on the evolution of the Osmundaceæ are well expounded, and a strong case made out, which would have been more convincing if the facts on the other side, brought forward by Kidston and Gwynne-Vaughan, had been dealt with.

The lower seed-plants are divided into Archigymnospermæ, including Cycadofilicales, Cycadales, Cordaitales and Ginkgoales, and

Metagymnospermæ consisting of the Conifers and Guetales. It is well point out that *Ginkgo* forms a link between the two main divisions. The long chapter on Coniferales is chiefly devoted to an exposition of the author's well-known view of the primitive position of the Abietineæ, and especially of *Pinus,* and the derivation of the ancient Araucarineæ from that group. This hypothesis is maintained with great ingenuity, in the face of much inherent improbability. The opposite view of the direct derivation of the Araucarineæ from their immediate Palæozoic predecessors, the Cordaiteæ, has been considerably strengthened by the work of Boyd Thomson and Burlingame.

The view, maintained by Wieland and his followers, of an affinity between the Bennettitales and the Angiosperms, is rejected. In this connection it may be pointed out that we have no actual proof that fertilization in *Bennettites* was by spermatozoids, as the author assumes.

The chapter on Herbaceous Dicotyledons is important, for it sets forth in detail the author's theory of their derivation from arboreal ancestors, a view which is well worthy of consideration. The author believes that the fresh and vigorous herbaceous vegetation will tend in future to supplant the forest trees; he has no such hopes, however, for the Monocotyledons, which he acutely remarks (p. 198), may be said to represent the second childhood of the vascular plants. "This group seems to have reached such a high degree of specialization that it will probably in the long run entirely disappear and be replaced by new derivatives of the still plastic dicotyledons" (p. 416). Such a consummation, however, is not likely to be reached while man remains dominant.

In the chapter on anatomical structure and climatic evolution, the question of annual rings is considered. While the author finds no such rings in Cordaitean wood from Prince Edward Island (Lat. 46° 30′) he believes that they are present in contemporary wood from Lancashire (Lat. about 53° 30′). The difference of latitude seems too small to be significant, and most appearances of annual rings in Carboniferous woods from any source are fallacious.

Chapter XXXI. is on a special subject, the evolutionary principles exhibited by the Compositæ, and is chiefly concerned with the somewhat narrow question of the distribution of oil-canals.

The concluding chapter is on anatomical technique, including the sectioning of coal and photomicrographic methods. On all these subjects the author is an acknowledged expert, and his counsels will be of the greatest value to practical workers.

The index might perhaps have been made fuller with advantage. No references are given in the book; the accumulation of references often becomes a burden, but a few would have been of service to the reader as a guide to his future studies.

In the present notice, attention has often been directed to points which seem open to criticism, or on which there is much difference of opinion. These divergences of view in no way detract from a high estimate of the great interest and complete originality of Professor Jeffrey's remarkable work.

The illustrations, as one would expect in a book by this author, are abundant and excellent.

D. H. S.

SPECIAL ARTICLES

ON THE SERIES IN THE ULTRA-VIOLET FLUORESCENCE OF SODIUM VAPOR

In two papers[1] published by Professor J. C. McLennan an account of the extension of Professor Wood's iodine vapor spectrum into the ultra-violet is put forth. Professor McLennan has not only proved that the resonance spectrum can not be obtained in the violet, but has also proved "that we have to do here with a case of ordinary fluorescence where Stokes's law is followed and where fluorescence is stimulated by the light from any one of a number of wave-lengths of a limited portion of the spectrum." In this case the fluorescence spectrum begins at $\lambda 4600$ and extends to $\lambda 2100$,

[1] J. C. McLennan, *Proc. Roy. Soc.*, LXXXVIII., p. 289; XCL., p. 23.

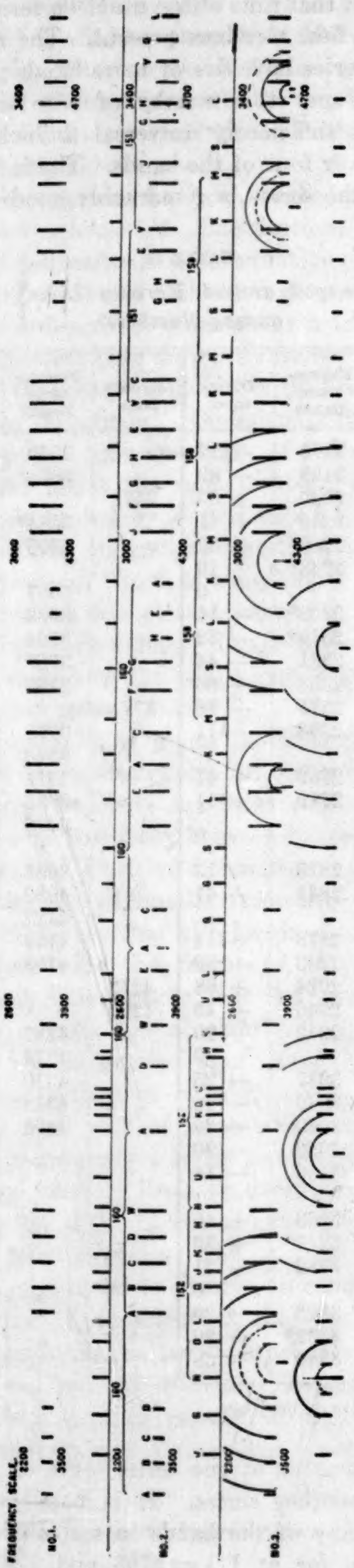

FIG. 1.

while the absorption region begins at λ2100, has a maximum between λ2000 and λ1900 and extends to λ1800.

The uranyl salts can also be stimulated by light of a wide range of wave-lengths and in the main Stokes's law is followed, although the fluorescence and absorption regions overlap. Like Professor McLennan's spectrum, the spectra of the uranyl salts appear to be unaffected by the mode of excitation, and while both spectra have been carefully tested for resonance, both have failed to show the phenomenon. For the above reasons it was thought that possibly the spectrum of the iodine vapor could be resolved into series of the same simple type as those found in the uranyl salts. If the wave-lengths of Professor McLennan's bands are converted into frequency numbers and plotted it is easy to discover series having constant intervals. Spectrum No. 1 in Fig. 1 shows the bands without any attempt at classification. It will be noted that the spectrum is in two sections because of its great length.

Professor McLennan notices several groups of bands which are spaced approximately 20 units apart. Such groups are present at $1/\lambda = 2400$ and at $1/\lambda = 3100$, but the series designated in spectrum No. 2 of Fig. 1 possesses much longer intervals. In this plot the members of the same series are given the same letter, and in addition a few have also been designated by long brackets. Such series as *A, V, N* and *M* are given brackets and the average value of the interval placed over the bracket. Here, as has so often been observed in the study of the uranyl spectra, a given series has a constant interval, but the various series have slightly different intervals. The value assigned to series *A* is 160, but this is an average value for the series, the actual intervals being given under Series *A* in Table I. as varying between 161 to 159 units. If the reader inspects the other series he will observe that the differences are generally unequal, but show no systematic deviation from a mean value. There are a few gaps in the series which may be caused by the presence of an exceedingly strong mercury line in the region

or by the dimness of the fluorescence. The fluorescence bands were located by reference to the strong lines of the mercury arc which served as the source of excitation.

TABLE I

Bands Arranged in Series of Constant Intervals

Series	λ	1/λ	Δ(1/λ)	Series	λ	1/λ	Δ(1/λ
A......	4608	2170		*L*.....	2883	3469	
	4290	2331	161		2760	3623	154
	4015	2491	160		......	......	153
	......	......	161		2545	3929	153
	3555	2813	161		2450	4082	153
	3365	2972	159		2360	4237	155
					2277	4392	155
B......	4550	2198			2195	4556	164
	4250	2353	155		2129	4697	141
C......	4505	2220		*M*.....	2715	3683	
	4210	2375	155		......	......	156
	......	......	158		......	......	157
	3725	2685	157		2408	4153	157
	3520	2841	156		2320	4310	157
	......	......	154		2237	4470	160
	3175	3150	155		2162	4625	155
D......	4452	2246		*N*.....	2799	3573	
	4170	2398	152		2685	3724	151
	3925	2548	150		2580	3876	152
E......	3800	2632		*O*.....	2900	3448	
	3585	2789	157		2774	3605	157
	3395	2946	157				
	3220	3106	160	*Q*.....	2737	3654	
	3065	3263	157		2622	3814	160
F......	3475	2878		*S*......	2476	4039	
	3290	3040	162		2382	4198	159
					2300	4348	150
G......	3445	2903			2218	4509	161
	3268	3060	157		2148	4655	146
	3107	3219	159				
	2960	3378	159	*U*.....	2667	3750	
	2825	3540	162		2560	3906	156
	......	......	157				
	2594	3855	158	*V*.....	3195	3130	
					3047	3282	152
H......	3420	2924			2915	3431	149
	3245	3082	158				
	3090	3236	154	*W*.....	4130	2421	
	2946	3394	158		3870	2584	163
	......	......	157				
	2697	3708	157	*K*.....	2628	3805	
					......	......	158
J......	3315	3017			2426	4122	159
	......	......	162		2340	4274	152
	2993	3341	162		2254	4437	163
	2853	3505	164		2179	4589	152
	2727	3667	162				
	2612	3828	161				

An argument against arranging the bands in series of constant intervals as outlined lies in the fact that nine of the nineteen series have less than four members present. The remaining ten series have five or more bands present, however, and it is worthy of note that the system is sufficiently universal to include all but three or four of the bands. The independence of the series is remarkably good—rarely does a member of one series serve as a member of another series. It is possible to arrange many of the bands in series of shorter intervals, for at $1/\lambda = 2793$ and $1/\lambda = 2793$

TABLE II

Bands Grouped around Mercury Lines (in Frequency Numbers)

Mercury Lines	Fluorescence Bands	Differences	Mercury Lines	Fluorescence Bands	Differences
	2170	+117		3540	+ 31
	2198	+ 89		3559*	+ 12
	2220	+ 67	3571		0
	2246	+ 41		3584*	− 13
	2255*	+ 32		3605	− 34
	2268*	+ 19			
2287		0		3667	+104
	2303*	− 16		3683	+ 88
	2319*	− 32		3724	+ 47
	2331	− 44		3737*	+ 34
	2353	− 66		3750	+ 21
	2375	− 88	3771		0
	2398	−111		3791	− 20
				3805	− 34
	2759	+ 41		3814	− 43
	2789	+ 11		3855	− 84
{2793 {2808		0		3876	−105
	2813	− 13		4039	+177
	2841	− 41		4082	+134
				4122	+ 94
	2878	+114		4153	+ 63
	2903	+ 89		4198	+ 18
	2924	+ 68	4212		
	2946	+ 46	4220		0
	2972	+ 20		4237	− 21
2992		0		4274	− 58
	3017	− 25		4310	− 94
	3040	− 48		4348	−132
	3060	− 68		4392	−176
	3082	− 90			
	3106	−114			
	3263	+ 40			
	3273*	+ 30			
	3282	+ 21			
3303		0			
	3323	− 20			
	3332*	− 29			
	3341	− 38			

* Geissler tube lines.

and $1/\lambda = 2992$ intervals of 90 units are present, at $1/\lambda = 3304$ intervals of 106 units, and at $1/\lambda = 3571$ intervals of 77 units, but these series of shorter intervals do not include as large a total number of bands as the series of longer intervals.

There appears, however, to be an entirely different scheme of classification, which is offered the reader as an alternative plan. It is found that several well-filled groups of bands can be arranged in pairs about a few centers. These centers take on more interest when it is found that they coincide with lines of the mercury spectrum. Occasional pairs from the Geissler tube spectrum of iodine can be arranged about the same centers, such lines being connected by dotted arcs in Spectrum No. 3. It is understood that Spectrum No. 3, like Spectrum No. 2, is a replica of Spectrum No. 1, which was plotted from the reciprocals of McLennan's values. The arcs in Spectrum No. 3 show how the bands can be grouped in concentric pairs.

In Table II. is given the frequency numbers of the mercury centers with the appertaining fluorescence bands, as well as the differences in frequency between bands and mercury center. Positive differences indicate that the bands are of smaller frequency and negative differences that the bands are of larger frequency than the frequency of the center. Although it is evident that the pairs are not always equally spaced about the centers the errors are no greater than those observed in the first method of classification. The mercury line or pair of lines which serves as a center is generally a fairly prominent line in a group of mercury lines, an exception being the first center, $1/\lambda = 2287$, or $\lambda = 4372$, which is a dim satellite of $\lambda = 4359$.

It is of interest to observe, in comparing the two plans of classification, that the second is not so universal in its application as the first, while the use of mercury centers suggests something akin to resonance, which is contrary to Professor McLennan's observations.

H. L. HOWES

PHYSICAL LABORATORY OF CORNELL UNIVERSITY,
October 30, 1917

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION G—BOTANY

THE only meeting of Section G for reading of papers took place at 2 P.M., Saturday, December 29, 1917, at the school of applied science, Carnegie Institute as a joint session with the Botanical Society of America and the American Phytopathological Society. The program consisted of the Vice-Presidential address followed by a Symposium on War Problems in Botany as outlined in the printed program. Dr. Bailey was prevented by war work from presenting his paper on the National Research Council. Dr. Coulter was not present, but his paper was read by Dr. H. C. Cowles. Dr. Smith was not present and his paper was not presented.

At the business meeting following the reading of papers, D. T. MacDougal was elected member of council, R. A. Harper member of Sectional Committee for 5 years and A. B. Stout member of general committee.

It was moved and carried that a committee be appointed by the chair to report to a later business meeting of the section on two considerations: (*a*) The organization of American botanists to forward the project of a pathological survey as suggested in the invitation paper of Dr. G. R. Lyman; (*b*) the possibility of assignment of drafted men of technical training and ability to scientific work of national importance and a recognition in some way that they are engaged in war service. The committee appointed by the chair consisted of G. R. Lyman. L. H. MacDaniels and C. L. Shear.

It was moved and carried that the business meeting adjourn till 9 A.M. Monday, December 31.

At the meeting of the Sectional Committee, December 29, the following members were present: Gager, Livingston, Blakeslee, Selby, MacDougal. Newcomb. Bartlett. Cook, Shear. A. F. Blakeslee was nominated for vice-president of the section for the ensuing year and Mel T. Cook for secretary for five years.

At the request of a group of botanical

editors the president and secretary of the section met with representatives from other botanical organizations to make plans for the publication of a journal of botanical abstracts.

At the business meeting 9 A.M., Monday, December 31, the committee on war activities of botanists reported resolutions which were adopted. These have already been placed in the hands of the permanent secretary.

A request was received from the organization committee of *Botanical Abstracts* for the election of two representatives from Section G on the board of control of *Botanical Abstracts*. B. T. Livingston was elected representative for four years and A. F. Blakeslee representative for two years.

A. F. Blakeslee,
Secretary

AMERICAN MATHEMATICAL SOCIETY

The twenty-fourth annual meeting of the society was held at Columbia University on Thursday and Friday, December 27–28, 1917, extending through two sessions on Thursday and a morning session on Friday. The attendance included forty-six members. Professors R. G. D. Richardson, of Brown University, and J. W. Young, of Dartmouth College, presided. The council reported the election to membership in the society of Dr. J. W. Campbell, Wesley College, Winnipeg; Dr. Mary F. Curtis, Western Reserve University; Mr. C. H. Parsons, Columbia University; Mr. J. B. Rosenbach, University of New Mexico; Mr. H. M. Terrill, Columbia University. Five applications for membership were received.

Committees were appointed to arrange for the summer meeting of the society at Dartmouth College in 1918 and for the summer meeting and colloquium at the University of Chicago in 1919.

The total membership of the society is now 735, including 77 life members. The total attendance at all meetings, including sectional meetings, during the past year was 338. The number of members attending at least one meeting during the year was 198. At the annual meeting 116 votes were cast for officers. The Treasurer's report shows a balance of $9,762.98, including the life membership fund of $6,333.13. Sales of the society's publications during the year amounted to $1,474.19. The Library now contains 5,475 volumes, excluding unbound dissertations.

At the annual election, which closed on Friday morning, the following officers and other members of the council were chosen: Vice-presidents, J. L. Coolidge and D. R. Curtiss. Secretary, F. N. Cole. Treasurer, J. H. Tanner. Librarian, D. E. Smith. Committee of publication, F. N. Cole, Virgil Snyder, J. W. Young. Members of the council to serve until December, 1920, R. C. Archibald, Dunham Jackson, D. N. Lehmer, J. B. Shaw.

The following papers were read at this meeting:

F. L. Hitchcock: "The coincident points of two algebraic transformations."

W. B. Carver: "The conditions for the failure of the Clifford chain."

C. J. Keyser: "The rôle of the concept of infinity in the work of Lucretius."

C. J. Keyser: "Concerning the number of possible interpretations of any system of postulates."

W. H. Wilson: "Systems of functional equations which define hyperbolic sine, hyperbolic cosine, sine and cosine uniquely."

C. H. Forsyth: "Tangential interpolation of ordinates among areas."

W. B. Fite: "Concerning the zeros of the solutions of certain differential equations."

R. L. Moore: "Concerning a set of postulates for plane analysis situs."

C. A. Fischer: "Integral equations involving Stieltjes integrals."

O. E. Glenn: "Preliminary report on a new treatment of theorems of finiteness."

C. L. E. Moore: "Rotations in hyperspace."

G. M. Green: "Memoir on the general theory of surfaces and rectilinear congruences."

J. F. Ritt: "On the iteration of rational functions."

Olive C. Hazlett: "On rational integral invariants and covariants of the general linear algebra."

Anna J. Pell: "Systems of linear equations."

Norbert Wiener: "Internal isomorphisms of complex algebra."

T. R. Hollcroft: "A classification of general (2, 3) point correspondences between two planes."

W. F. Osgood: "Singular points of analytic transformations."

M. T. Hu: "Linear integro-differential equations with a boundary condition."

Frank Morley: "Some general projective invariants of the algebraic plane curve."

Abstracts of the papers will appear in the March number of the *Bulletin* of the society.

The Chicago Section of the society met at the University of Chicago on December 28–29. The next regular meeting of the society will be held at Columbia University on February 23.

F. N. Cole,
Secretary